Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
1998 Biennial Regulatory Review —	)	CC Docket No. 98-163
Modifications to Signal Power Limitations	)	
Contained in Part 68 of the Commission's	)	
Rules	)	

COMMENTS OF U S WEST COMMUNICATIONS, INC.

U S WEST Communications, Inc. ("U S WEST") hereby submits its Comments in the above-captioned proceeding.

In its September 16, 1998 Notice of Proposed Rulemaking in this docket, the Federal Communications Commission ("FCC") proposed to modify the Part 68 rules to relax the signal power limitations which currently apply to pulse code modulation ("PCM") modems.[1] The Notice proposes to increase the maximum signal power allowed a PCM modem from the current -12dBm (decibels – milliwatt) to a maximum of - 6dBm (or some other number to be identified in the comments). The Notice correctly observes that such relaxation would permit PCM modems (the modem in question often being identified as a V.90 modem) to increase the speed at which they transmit data.

U S WEST does not oppose the proposed rule changes to accomplish this result (although testing is not yet complete in order for anyone to determine whether modems which comply with the suggested new signal power limitations

[1] See In the Matter of 1998 Biennial Regulatory Review – Modifications to Signal Power Limitations Contained in Part 68 of the Commission's Rules, CC Docket No. 98-163, Notice of Proposed Rulemaking, FCC 98-221, rel. Sept. 16, 1998 ("Notice").

can in fact be attached to the public switched network without harming the network). To the extent that the FCC's Part 68 rules are impeding the delivery of the highest quality telecommunications services to the public, these rules must be modified or eliminated. However, the fact that this technical modification is being resolved in a federal regulatory proceeding indicates that changes far more dramatic than simply modifying the Part 68 rules as they apply to a specific type of modem must be enacted. We have several observations.

First, in this increasingly competitive telecommunications marketplace, the Part 68 rules are becoming increasingly anachronistic. Part 68 was adopted in order to prevent the pre-divestiture AT&T from misusing its market power by claiming that competitive customer premises equipment ("CPE") should not be connected to the network because of speculated "network harms." CPE which complied with the Part 68 rules was presumptively connectable to the public switched network — because Part 68 only permitted registration of CPE which did not harm the network.[2] Given AT&T's huge market power in the local exchange, long distance, and CPE manufacturing markets, regulatory intervention in the network interconnection and CPE registration fields was warranted and salutary.

However, as the instant Notice demonstrates, standards development and validation by the federal government is also unwieldy and often inefficient. Here, the FCC has proposed to modify a rule which would have the legal effect of a federal

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[2] The FCC's Part 68 Registration Program was adopted in 1975. See In the Matter of Proposals for New or Revised Classes of Interstate and Foreign Message Toll Telephone Service (MTS) and Wide Area Telephone Service (WATS), First Report

decree that modems compliant with the new signal power limitation can be connected to the public switched network without causing technical harm to the network. If the FCC is correct, all to the good. But if the FCC errs in this determination, serious public harm could be the result, because the FCC's rule would become binding on all affected carriers with the force and effect of law. It is self evident that the FCC's rules cannot have any impact on the laws of nature, which will run their course no matter what the FCC decrees.

This simple fact would dictate that the FCC be quite conservative in determining whether to issue a rule which requires carriers to connect a particular piece of CPE to their networks. But such conservatism, while appropriate in the case of a regulatory agency confronted with complex and important technical decisions of long-lasting consequence, is clearly not always the best approach for the public. Industry standards bodies are far superior to a federal regulator in facing the task of assessing what types of equipment should be attachable to the public switched network, and under what conditions. The entire notion that a federal agency can optimally determine, in a potentially adverse administrative proceeding, just what equipment can be safely attached to the public switched network, is not a reasonable one. When AT&T exercised its past market power prior to divestiture, such federal intervention was appropriate and quite successful. Such is no longer the case in today's market.

In this context, it is important to realize that the American National

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and Order, 56 FCC 2d 593 (1975) ("Report and Order"). In the Report and Order, the FCC addressed signal power limitations. See id., 56 FCC 2d at 607-08 ¶¶ 37-40.

Standards Institute ("ANSI") accredited Committee T1 standards body is at this very moment addressing the precise questions posed by the Notice. Standards Committee T1 has developed a technical report containing test procedures. This technical report is currently under ballot by Committee T1 members; it is expected that this technical report will be approved and be available to interested industry members for testing by November 6, 1998. The test plan will investigate the potential for crosstalk induced by PCM modems operating at the proposed -6 dBm level. The Technical Report was developed because the crosstalk analysis modeling and preliminary testing (apparently what was relied on by the FCC in adopting the tentative conclusions in the Notice) was not considered compelling or conclusive enough to support a decision to recommend a power level waiver or modification for the PCM modems.

Two U S WEST documents summarize the issues and where the anticipated testing can be expected to lead.

- ITU, Study Group 16, Contribution PCM 97-029, dated July 7-11, 1997, one of the seminal documents on the issue, concludes that the signal power limitations should be relaxed along the lines set forth in the Notice. This document presents a crosstalk analysis model study indicating that V.90 modems transmitting power levels at a proposed -6 dBm level will raise idle channel noise levels to 13.3 dBrn, below the objective of 18.5dBrnC. This document is attached hereto as Exhibit A.
- Bellcore Contribution TR 41.9/97-11-083, dated November 18, 1997, which recommends physical testing prior to approval of the relaxed signal power

limitations for PCM modems. This document is attached hereto as Exhibit B.

Review of these documents gives a good overview of the nature of the technology and the issues raised in the Notice. The documents also demonstrate why FCC action at this time would be premature. The testing which will permit a judgment to be made as to whether relaxing the signal power limitations for PCM modems has not yet been accomplished. Once the testing has been completed (and it appears that such action is progressing quickly), the industry and the FCC can reasonably evaluate whether the industry's standards and the FCC's rules should be modified.

In conclusion, we completely concur in the basic premise of the Notice — FCC rules should not unnecessarily restrict customer choice of CPE or network innovation. In fact, at this stage in the development of the telecommunications marketplace, we submit that it is time to reevaluate the wisdom or necessity of the Part 68 regulatory structure in its entirety. On the issue presented in the Notice,

the FCC should simply await the anticipated industry test results and, thereafter, act in a manner consistent with those tests.

Respectfully submitted,

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October 29, 1998

EXHIBIT A

ITU - Telecommunications Standardization Sector **PCM'97-029**

Study Group 16 - Question 23

V.pcm Rapporteur Meeting, Dublin, Ireland, July 7-11, 1997

SOURCE: **General DataComm, Inc.**

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TITLE: **Analysis of -12 dBm Power Limit**

ABSTRACT

Several contributions and liaisons have suggested various harmful or undesirable consequences could occur if the signal power of the PCM modem exceeds -12 dBm. This contribution discusses these potential harms. Based on industry standards, telephone industry equipment standards, and published crosstalk models, we conclude that the signal power limit could be increased significantly without harmful effects on the network or other users.

INTRODUCTION

Under present FCC rules [1], if equipment "generates signals in digital form which are intended for eventual conversion into voiceband analog signals", the equivalent signal power must be limited to less than -12 dBm when averaged over a three second interval. This regulation applies to the "downstream" transmission from a PCM modem. The signal power limitation limits the signal-to-noise ratio that can be achieved, and thus limits the maximum data rate that can be achieved.

If this signal power limit could be relaxed without causing harm to network equipment or other users, the data rate achievable with this technology would be increased. This would increase the utility to the user, make more efficient use of the network, and could potentially reduce call holding times and contribute to a reduction in network congestion.

The historical reasons for the signal power limit, and the possible effects of allowing a higher signal power, have been discussed in various fora, including TR30.1 (modems), TR41.9 (Regulatory Issues), T1A1.7 (Network Performance for Voice and Voiceband Data), and T1E1.4 (Network Interfaces).

It is believed that the main reason for the signal power limit was to prevent overload on analog FDM carrier systems [2]. In these systems, a "hot" channel could cause intermodulation distortion which affected many other channels. These analog carrier systems may still exist, but in very small numbers. In any event, the PCM modem analog signal will never be carried on trunk circuits (see below).

Also, there is some precedent for higher signal levels on the local loop. DTMF signalling is allowed at up to 0 dBm. The "Receiver Off Hook" Signal is sent at a very high level. Voiceband modems used on "private lines" are capable of signal levels up to 0dBm. Although the private line circuits are specially engineered, they share the loop plant with POTS.

A liaison from T1A1.7 [3] identified the following as possible harmful effects of allowing a higher signal power (quoted verbatim):

- crosstalk induced in the loops of other services in the same binder group as the PCM modem facility;
- crosstalk induced in central office jumper wires in close proximity to those of the PCM modem path jumper wires;
- crosstalk between central office switch ports in close proximity to each other;
- the effects of high average power levels on central office switch line card and digital facility channel unit components.

ASSUMPTIONS

1. The PCM mode of operation is only possible when there is just one D-to-A conversion in the channel. This conversion will occur in the line card of a digital switch or IDLC. Thus, the only place that the signal exists as an analog signal is on the two-wire loop between the line card and the subscriber.
2. The modem start-up sequence will be able to detect whether there is more than one D-to-A conversion, and in this case will revert to V.34 mode with the normal -12 dBm power limit. The analog form of the PCM modem signal will never occur on analog trunks or analog carrier systems.
3. On the digital portion of the connection, the network need not know (or care) that the encoded analog content is a PCM modem signal. Disabling of Echo Cancellers will be accomplished in the normal way. In the digital domain, bit patterns corresponding to high analog signal levels are just bits, and do not cause crosstalk or other harms (while in digital form).

CROSSTALK ANALYSIS

The PCM modem spectrum will be essentially flat and "noise-like" (except for a brief start-up sequence at the beginning of a call). It is passed through the codec filter, so there is very little energy above 4 KHz. The only other services that this spectrum might interfere with are other voiceband services. Any perceptible crosstalk to another channel would appear as an increase in the noise floor, not as single-frequency interference or "intelligible" crosstalk.

Using the crosstalk model of T1.413 (the ADSL standard), we calculated the worst-case crosstalk to another pair in the same binder group [4]. This model assumes that crosstalk loss decreases as $f^{1.5}$, i.e., less loss (more crosstalk) with increasing frequency. This calculation used 49 interferers for a worst-case, and resulted in a crosstalk loss of 70.7 dB for the PCM modem spectrum. (See Appendix for details.)

This means that if 49 PCM modems transmit at -6 dBm in the same binder group, The crosstalk to the 50th pair will be -76.7 dBm, or 13.3 dBrn. These numbers are not C-message weighted.

For comparison, the crosstalk coupling loss requirements for a digital switch are 80 dB (objective) and 75 dB (requirement) [7]. This is from any port to any other port, but does not include multiple interferers.

Similarly, the crosstalk coupling loss requirement for an IDLC is 65 dB [5][6]. This is also measured from any port to any other port. Thus we see that the worst case coupling loss for the PCM modem signal in the loop is 4.3 dB worse than the crosstalk required for a switch, and 5.7 dB better than the crosstalk requirement for IDLC.

In terms of noise levels, if we assume a -6 dBm transmit level, the noise due to crosstalk is 13.3 dBrn. This is less than the idle channel noise objective for the switch or IDLC which is 17-18 dBrnC.

We conclude that a transmit level of -6 dBm for the PCM modem would not have any significant effect on other voiceband services. Using worst-case assumptions, the signal power due to cable crosstalk is of the same order as the crosstalk allowed in network equipment, and it is well below the limit for idle channel noise in network equipment.

Another crosstalk issue is crosstalk in CO jumper wires. Presumably, the characteristics of these wires (twist and routing relative to other pairs) are not as well controlled as the pairs within a cable binder group. We do not have any data that would allow an analysis of this issue. However, we note that CO jumpers will only be in close proximity for short distances (less than 100 ft.?), while cable pairs may be in close proximity for many thousands of feet.

EFFECTS OF HIGH SIGNAL LEVELS

Another concern is the effect of high power levels on components in line cards or channel units. Examination of LSSGR and IDLC specifications indicates that this should not be a problem.

First, the components of a line card which are directly connected to the loop must handle relatively high voltages and currents for loop battery and ringing. They also must meet lightning surge and overvoltage requirements. The milliwatt level voiceband signals are not a concern for these components.

Components in the AC signal path are also designed to handle much higher signal levels than -12 dBm. The transfer function of the mu-law codec is defined such that a sine wave whose peak value is the most positive and most negative digital codes, has an analog signal power of 3.17 dBm.

For both the switch and the IDLC [5][6][7]:

- Frequency Response (amplitude distortion) is specified and measured at 0 dBm
- Amplitude Tracking is specified over a range including +3 dBm
- Signal-to-Distortion Ratio is specified up to 0 dBm
- Single Frequency Distortion is tested with a 0 dBm input signal
- Crosstalk is characterized at a 0 dBm input level
- Overload Compression is specified at levels up to +9 dBm

Clearly, network equipment is expected to perform properly at levels up to 0 dBm, and tolerate even higher levels without damage.

Finally, the modem start-up sequence includes a "line probing" algorithm which includes measurement of harmonic/intermod distortion. If distortion is detected, the modem will reduce the transmit level to reduce the distortion and optimize the level for that particular channel.

CONCLUSION AND RECOMMENDATIONS

We have shown, based on standard crosstalk models, and industry-standard performance requirements for network equipment, that relaxing the Part 68 signal power limit for this application will have no harmful effects on network equipment or other users. We believe a transmit level of -6 dBm will provide the benefits of higher data rates for modem users, without any negative effects.

REFERENCES

[1] Code of Federal Regulations (CFR), Title 47, Part 68, "Connection of Terminal Equipment to the Telephone Network". The specific regulations for encoded analog content are 68.308 (h) (1) [iv] and 68.308 (h) (2) [v].

[2] TIA/EIA Bulletin TSB31-A, "Part 68 Rationale and Measurement Guidelines", February 1992.

[3] T1A1.7/97-008, "Liaison to TIA TR41.9 Regarding Transmission Performance Issues Related to PCM Modems", January 23, 1997.

[4] ANSI T1.413-1995, "Network and Customer Installation Interfaces- Asymmetric Digital Subscriber Line (ADSL) Metallic Interface. Annex B contains the crosstalk model.

[5] GR-303CORE, "Integrated Digital Loop Carrier Generic Requirements, Objectives, and Interface", Issue 1, September 1995, Bellcore.

[6] TR-TSY-000057, "Functional Criteria for Digital Loop Carrier Systems", Revision 1, November 1988, Bellcore.

[7] TR-NWT-000507, "LSSGR: Transmission, Section 7", Issue 5, December 1993, Bellcore.

Appendix- Crosstalk Model

First, we assume the PSD of the PCM modem signal is essentially flat from 100 Hz to 4 kHz. This is a worst-case assumption because the codec filter actually begins rolling off around 3400 Hz. For a reference level, assume that the total power is 0 dBm (1 mW). Then:

$$P = \int_{100}^{4000} p(f)df = 1 \text{ mW}$$

where $p(f)$ is a constant with units watts/Hz. Solving for $p(f)$ gives

$$p(f) = 2.56 \times 10^{-4} \text{ mW/Hz}$$

The crosstalk transfer function, given in ANSI T1.413 is:

$$\frac{PSD_{XT}}{PSD_{Disturber}} = x_n f^{3/2}$$

where $x_n = 0.882 \times 10^{-14} \times n^{0.6}$

and $n =$ number of disturbers

The above transfer function is for a 100 ohm system. We assume that the effective source impedance is high compared to the system impedance. Therefore the crosstalk power should be proportional to the system impedance, which is greater at voiceband frequencies. So the correction factor for voiceband signals is:

$$P_{corr} = \frac{900}{100} = 9.0 = 9.5 \text{ dB}$$

The PSD of the crosstalk is:

$$PSD_{XT} = 9.0 \times p(f) \times x_n f^{3/2}$$

Using n=49 as worst-case, and integrating, the total crosstalk power is:

$$P_{Total} = \int_{100}^{4000} PSD_{XT} df = 8.497 \times 10^{-8} \text{ mW} = -70.7 \text{ dBm}$$

If the disturber power is -6 dBm instead of 0 dBm, the total crosstalk power will be -76.7 dBm.

EXHIBIT B

TIA ENGINEERING SUBCOMMITTEE TR 41.9
CONTRIBUTION

DOCUMENT NUMBER:	TR 41.9/97-11-083
DATE:	November 18, 1997
SUBJECT:	Considerations Regarding PCM Modem Output Signal Power
SOURCE:	Bellcore
CONTACT(S):	Barry Lerich 445 South Street - MCC 1A-140G Morristown NJ 07960-6438 (973) 829-2959 FAX: (973) 829-5866 email: blerich@notes.cc.bellcore.com
ABSTRACT:	There has been a considerable amount of discussion regarding the equivalent power level of the encoded analog content of the signal output of the recently introduced PCM vis-à-vis the FCC Rules and Regulations Part 68 constraint of -12 dBm. This contribution summarizes that material and provides the Bellcore transmission engineering community position and recommendation concerning a path forward to resolve the issue.
DISTRIBUTION:	Participants of TIA Engineering Subcommittee TR 41.9

Considerations Regarding PCM Modem Output Signal Power

Introduction

There has been a considerable amount of discussion regarding the equivalent power level of the encoded analog content of the signal output of the recently introduced PCM vis-à-vis the FCC Rules and Regulations Part 68 constraint of -12 dBm. This contribution summarizes that material and provides Bellcore's position and recommendation concerning a path forward to resolve the issue.

References

1. Contribution T1A1.7/96-041, Regulatory and Performance Issues Relating to "PCM Modems", Motorola ISG, October 30-31,1996.
2. Contribution T1A1.7/96-044, Liaison to ANSI T1E1.4, TIA TR-41 and TR-30.1 on FCC Part 68 Compliance for "PCM" Modems, T1A1.7 Chair, October 30-31, 1996.
3. Contribution T1A1.7/97-006, Liaison from TR41.9 to T1A1.7 TR41.9/97-02-002), TR-41.9 Chair, January 14, 1997.
4. Contribution T1A1.7/97-007, Report of Ad-Hoc Meeting of October 31, 1996, Ad-Hoc Chair, January 22, 1997.
5. Contribution T1A1.7/97-008, Liaison to TR-41.9 Regarding Transmission Performance Issues Related to PCM Modems [Copy to T1E1.4].
6. Contribution PCM'97-029, Analysis of -12 dBm Power Limit, General DataComm, Presented at the ITU-T V.PCM Rapporteur Meeting July 7-11,1997.

Summary of Major Points in References

Following is a summary of major points from the references with associated analysis and comment from Bellcore shown in bold italic font.

- Reference 1 raised network-related issues with the potential to impact the standardization and deployment of PCM Modem technology, and requested T1A1.7 views on the issues. Summarized T1A1.7 responses (References 2, 4, and 5), supported by Bellcore, as follows:
  - FCC power constraint was based on the potential to induce crosstalk in other proximate circuits, the potential to generate distortion in network elements, and the potential to cause analog multichannel carrier overload.
  - PCM modems must conform to the FCC constraint.
  - Testing required to determine the effects before any request for waiver, modification, or removal of the power constraint in the case of PCM modems.
  - Absent any testing data, T1A1.7 believes that crosstalk induced in proximate facilities by a PCM modem transmitting above -12 dBm will be a problem.
  - Absent any testing data, T1A1.7 believes that non-linear distortion generated in network element components PCM modems transmitting above -12 dBm will be a problem.
- Reference 3 provided additional information regarding the origin of the FCC power constraint taken from TIA TSB31A and concluded that further research was

necessary to determine acceptable dynamic range limits. TR41.9 also indicated that field-trial data would be helpful in bringing this matter to closure. The applicable sections for the constraint on encoded analog content power level in the V.PCM case, as correctly indicated in Reference 6, are Part 68.303 (h) (1) [iv] and 68.308 (h) (2) [v].

We note that the section quoted from TSB31A applies to analog data and therefore is not applicable to the digital signal from a V.PCM remote access server (RAS) entering the PSTN. These requirements probably would apply if the intent is to raise the output power from the subscriber V.PCM modem to achieve higher upstream data rates.

- Reference 6 raised several points that warrant clarification:
  - Paragraph 2 of the Introduction indicates that higher data rates could potentially reduce call holding times and contribute to a reduction in network congestion.

    We could also assume a scenario in which improved data rates make transfer of images less frustrating, thereby, encouraging more use and longer holding times.

  - Paragraph 5 of the Introduction states 'DTMF signaling is allowed at up to 0 dBm. The "Receiver Off Hook" signal is sent at a very high level.'

    These "tone" type signals as well as test tones may be transmitted at high levels, but such tones are planned to be of relatively short duration. Test tones are commonly applied at TLP (Transmission Level Point) on voice circuits and a 13 dB below TLP on data circuits. The PCM modem RAS signal will, in all probability, result in a long duration disturber in the subscriber loop between the line card and the subscriber's modem.

  - Paragraph 5 of the Introduction further states 'Voiceband modems used on "private lines" are capable of signal levels up to 0-dBm."

    While voiceband modems may transmit signals at up to 0-dBm on private lines, these services all include network channel terminating equipment that modify the level at the network interface. The network is generally designed for -12/-13 dBm signals on the average. On the other hand, the PCM modem RAS signal is digital and is converted to analog at the line card interface to the subscriber loop. We are concerned with the level of the analog signal on the subscriber loop, not on the digital portion of the connection. Consequently, the encoded analog content signal should be bound by the FCC power constraint until we are certain that a higher level will not generate customer-perceptible impairments on the subscriber loop.

  - The Crosstalk Analysis section of the contribution addresses the crosstalk on the digital subscriber line and in digital switches and DLC equipment.

    This analysis appears to be accurate rom a theoretical standpoint, but

we are concerned with the assumption of a flat spectrum. It is our understanding that the PCM modem technology employs some spectral shsping and it is unknown how this will affect the potential crosstalk in the subscriber loop. These concerns mitigate in favor of some testing before supporting a request for waiver of the FCC power level constraint of -12 dB.

- The section on Effects of High Level Signals indicates that line card or channel unit components must meet lightning surge and over-voltage requirements; high voltages for loop battery and ringing are present; milliwatt voiceband signals and several other test requirements are also presented.

  Protector devices on the frame between line card/channel unit components and the loop to which they are connected are designed to open in cases of lightning or over voltage, so that these hazards are not applied to the components. Loop battery results in currents on the order of 20 ma to 70 ma. The real concern in the components of the line card is non-linear distortion of the signal that can generate disturbing steady-state signals and crosstalk in adjacent loops or line cards. Ringing voltages and test tones are of relatively short duration, and, therefore, are of less concern. In addition, the test ranges cited are for tests that are performed on isolated switch and DLC components to determine if they meet the manufacturing criteria and, in some cases, for service turn-up requirements. They are not tests that are performed on a routine basis on working services.

- We understand that there was some discussion at the August meeting concerning the location of the test point at which the test is conducted for encoded analog content equivalent power level measurement. The Part 68 rule places the measurement point on the digital transport. The PCM modem representative suggested that the test point be moved after any padding was inserted into the connection. The modems would determine the power level and adjust accordingly. However, it was discussed that there is no standard way of implementing pads in the various switches used in the network, nor is there a standard transmission plan in use across the domestic PSTN. There are 3 dB and 6 dB pads (digital and analog) but there are cases of 2 dB and 4 dB pad implementations. There was concern on how well PCM modems could probe such a wide variance.

  We concur in the TR41.9 decision to maintain the test point for measuring the power level as specified in the current FCC Part 68. Until a fixed loss plan, consistent across the population of switches and service providers, is fully implemented, the only constant reference is at the digital point. It is Bellcore's opinion that a minimum loss is needed on the local cable (metallic pair) so as not to raise the idle circuit noise of any connection; be it data or voice.

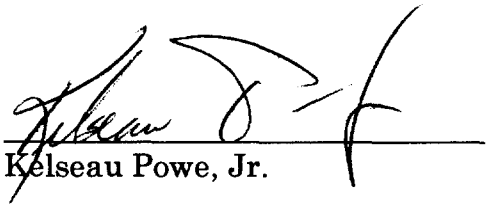
Conclusion

The foregoing discussion addresses several issues attendant to the introduction of V.PCM modem technology into the network. Bellcore believes that solutions should be sought to enable the introduction of new technology, so that end-users can benefit from the added capabilities. Our major concern is the potential for the generation on

subscriber voiceband services of customer-perceived impairments that did not exist before the introduction of the new technology. Consequently, we believe that, until test data is obtained to show that these concerns are unfounded, Bellcore cannot support a request to change the FCC mandated Part 68 constraint on the maximum equivalent power of encoded analog signals input into the public network.

CERTIFICATE OF SERVICE

I, Kelseau Powe, Jr., do hereby certify that on this 29th day of October, 1998, I have caused a copy of the foregoing **COMMENTS OF U S WEST COMMUNICATIONS, INC.** to be served, via hand delivery, upon the persons listed on the attached service list.



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